NDIDATE'S NUMBER

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TM
D-22?

Physics 30
Supp. 1967

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DEPARTMENT
EDUCATION ALBERTA

HIGH SCHOOL AND UNIVERSITY MATRICULATION EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1967

SUPPLEMENTAL

PHYSICS 30

Time — 3 hours.

Total Possible Mark — 174.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE QUESTIONS CAREFULLY.

Mathematical tables, slide rules and geometry sets may be used.

Complete solutions must be shown for all problems.

Rough and finished work may be done in pencil or ink (Blue or Black).

DO NOT FOLD THIS BOOKLET.

Place your test booklet in the answer envelope in such a way that the UPPER LEFT HAND CORNER OF THE BOOKLET (Candidate's Number) shows through the SLASHED CORNER of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

Constants:

$g = 980$ cm/sec^2 or 32 ft/sec^2
$J = 4.2$ joules/cal.
Density of mercury = 13.6 gm/cm^3
Specific heat of copper = 0.090
Heat of fusion of ice = 80 cal/gm or 144 BTU/lb
Melting point of copper = 1080° C
Calorific value of alcohol = 12,000 BTU/lb
Heat of vaporization of water = 970 BTU/lb
Heat of fusion of copper = 49.0 cal/gm at 1083° C

(For the use of Sub-examiners only)

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ROUGH WORK ONLY

(No marks given for work in this space)

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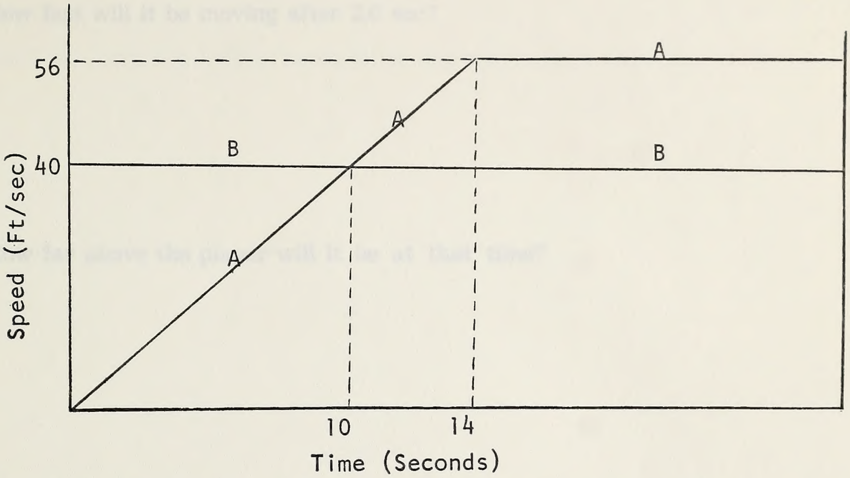
QUAECUMQUE VERA

Values

1.



Car A has just started as car B passes it moving at a constant speed of 40 ft/sec. Their speed-time graph is shown above.

1 (a) How long does it take car A to be moving as fast as car B?

2 (b) At that time, how many feet is car B ahead of car A?

2 (c) What is the acceleration of car A during the time it is accelerating?

4 (d) Which car is ahead, and and by how much, at the end of 20 seconds?

ROUGH WORK ONLY

(No marks given for work in this space)

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Values

2. A baseball is thrown straight up with a speed of 48 ft/sec.

2 (a) How fast will it be moving after 2.0 sec?

3 (b) How far above the player will it be at that time?

2 (c) What is the acceleration of the baseball at the top of its rise?

4 **3.** A wagon of mass 40 lb is moving with a velocity of 10 ft/sec. A boy of mass 120 lb jumps off the back with a velocity of 10 ft/sec relative to the wagon so that he is not moving relative to the ground. What happens to the motion of the wagon?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4. A balloon is tethered by a cable making an angle of 60° with the ground. The buoyancy of the balloon is 300 lb wt.

4 (a) Find the horizontal force exerted by the wind on the balloon.

2 (b) Find the tension in the cable holding the balloon.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

6 **5.** A square hole is punched in a uniform circular thin sheet of metal, a diagonal of the square being a radius of the circle. One corner of the square lies at the center of the circle with the diagonally opposite corner lying on the circumference. Find the position of the center of gravity of the remainder.

3 **6.** A board supported at both ends will break if loaded with 175 lb at the middle. However, if it is used at an angle of 30° to load a 200 lb crate on the back of a truck, it does not break. Explain.

1 **7.** Is it possible to weigh a 100-gram mass using two spring balances each of which can weigh a maximum of 75 grams? Explain.

[OVER]

ROUGH WORK ONLY

(No marks given for work in this space)

Values

5 **8.** A passenger on a ship moving due north at 12 knots observes that the smoke from the funnels appears to drift south-east. When the ship is at rest ,the smoke drifts east. Find the velocity of the wind.

8 **9.** A balloon weighing 1600 lb wt is moving downwards with an acceleration of 1.0 ft/sec/sec when ballast of 100 lb wt is thrown out. Find the new acceleration both in magnitude and direction.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

10. A painter lifts himself to the top of a building by a pulley system having two wheels in the upper fixed block and one in the lower movable block. The painter and equipment together weigh 240 lb wt.

3 (a) What is the tension in the rope?

1 (b) What is the tension in the support of the fixed block?

3 (c) If the painter is lifted by another man standing on the ground what is the effort applied by him?

1 (d) What would be the supporting force now in the upper fixed block?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

11. A pendulum has a bob whose mass is 100 gm. At either end of the highest points of the swing the bob is 10 cm higher than it is at the lowest point of its swing.

2 (a) How much more potential energy does the bob have at its highest points than it has at its lowest point?

2 (b) What is the kinetic energy of the bob when it passes through its lowest point?

3 (c) What is the velocity of the bob at its lowest point?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **12.** A U-tube contains a quantity of mercury. Water is poured into one limb, until the mercury stands 1.0 inch higher in one limb than in the other. Find the height of the column of water.

13. A solid cylinder of specific gravity 0.80 floats with its axis vertical in water.

2 (a) Calculate the portion of its length which is immersed in the water.

5 (b) If oil of specific gravity 0.60 is now poured on the surface of the water until the cylinder is just immersed, find the fraction of its length which is now immersed in the water.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

2 **14.** An ungraded thermometer is attached to a centimeter scale and is found to read 7.4 cm in melting ice, 23.9 cm in steam at 100° C and 4.1 cm in a freezing mixture. What is the temperature of the freezing mixture?

2 **15.** Find the linear expansion of a metal rod one foot long per Fahrenheit degree if the coefficient of linear expansion for the metal is 0.000045 $\frac{\text{cm}}{\text{cmC}^\circ}$

3 **16.** Find the coefficient of linear expansion of the glass in a flask which contains a liquid whose coefficient of real volume expansion is $5.00 \times 10^{-4}/^\circ\text{C}$ and coefficient of apparent volume expansion is $4.73 \times 10^{-4}/^\circ\text{C}$.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **17.** If the density of water at 4° C is 1.0000 gm/cm^3 and at 60° C is 0.9834 gm/cm^3, find its mean coefficient of volume expansion between 4° C and 60°C.

18. A block of copper of mass 200 gm is dropped on a block of ice at 0° C.

4 (a) What was the initial temperature of the copper if it melts 210 gm of ice?

2 (b) Which takes longer to melt, one gram of ice or one gram of copper? Explain. (Assume that each is at its melting point and heat is supplied at the same rate for both.)

ROUGH WORK ONLY

(No marks given for work in this space)

Values

6 **19.** A mass of 20 kilograms falling a total distance of 180 cm churns up 180 gm of water contained in a vessel of water equivalent 20 gm. Find the change in the temperature of the water. The water equivalent of the 20 kilogram mass is 200 gm.

6 **20.** 1.90 lb of dry snow at a temperature of 32° F is placed in a kettle and heated on an alcohol stove until the resulting water is at boiling point. Calculate the mass of alcohol burned if the water equivalent of the kettle is 0.10 lb. Assume there is no heat wasted.

The calorific value of alcohol is 12,000 BTU/lb.

The latent heat of fusion of ice is 144 BTU/lb.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

21. A battery having an internal resistance of 0.60 ohm and an EMF of 12 volts is connected to a 5.4 ohm lamp.

1 (a) What is the total resistance in the circuit?

1 (b) What is the current?

1 (c) What is the terminal voltage of the battery?

1 (d) What part of the EMF drives the current inside the battery?

2 (e) At what rate in watts is heat developed in the lamp?

2 (f) What would be the current in the circuit if another similar 12-volt battery were added in parallel to the original battery?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **22.** If the force on a charge placed 1.5 cm from another charge is 1.8×10^{-3} dynes, what is the force when the separation is 0.50 cm?

2 **23.** How much work is done by a 3.0 ampere current flowing for 20 sec between two points with a potential difference of 15 volts?

24. Two similar metal balls, A and B, are mounted on insulated stands. Ball A has a negative charge.

3 (a) Describe how ball A can be used to give ball B a positive charge.

1 (b) What is the largest positive charge ball B can acquire in this way?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

25. A photoflash lamp operates for 1.0×10^{-3} seconds during which time a charge of 0.048 coulomb is transferred.

2 (a) What is the average current?

1 (b) How many electrons pass through the lamp assuming one coulomb is equivalent to 6.25×10^{18} electrons?

5 **26.** An atom of a metal of valence 2 has a mass of 1.0×10^{-22} gm. What mass of this metal will be plated on the cathode of a voltameter if a current of 4.0 amperes flows for 10 min? (One coulomb $= 6.25 \times 10^{18}$ electrons.)

ROUGH WORK ONLY

(No marks given for work in this space)

Values

27. The ends of a straight length of wire are connected to a galvanometer and the wire is then held between the poles of a horseshoe magnet.

1 (a) Assuming the wire is moved at constant speed in what direction must it be moved in order to have the maximum EMF induced in it?

1 (b) What effect does changing the speed of the wire have on the magnitude of the induced EMF?

1 (c) In what direction in the magnetic field may the wire be moved without inducing an EMF in it?

4 **28.** How many calories of heat are developed in 70 sec by an electric iron of resistance 20 ohms connected to a 120-volt circuit?

2 **29.** Show by diagram how two or more 2-ohm resistors may be connected to give a total resistance of:

(a) 0.5 ohms (b) 2 ohms

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **30.** A given piece of wire 1.5 mm in diameter has a resistance of 0.020 ohms/mm of length. What diameter would give it a resistance of 8.0 ohms/mm?

31. A dry cell has an EMF of 1.55 volts and an internal resistance of 0.0800 ohm.

3 (a) What current is flowing through a bulb when the terminal voltage of the cell is 1.31 volts?

1 (b) What would happen to the bulb if the voltmeter used to measure the voltage was connected in series instead of in parallel?

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ROUGH WORK ONLY

(No marks given for work in this space)

Values

32. Four 440-watt heaters are connected to a 110-volt line. Each heater can be turned on or off independently.

2 (a) What is the increase in the main current as each heater is turned on?

2 (b) If the fuse in the main line blows out when the main line current exceeds 15 amperes, how many heaters can be operated at the same time?

3 **33.** A shunt-wound motor connected to a 115-volt supply has an armature resistance of 0.20 ohms and a field resistance of 120 ohms. Calculate the total current taken by the motor if it is turning fast enough to develop a back EMF of 109 volts.

1 **34.** Why do the house lights dim when the furnace motor starts up?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

6 **35.** In a gasoline engine the hot gases expand in the ratio of 8:1, that is, the final volume is eight times the initial volume. If the initial temperature is 1000° C at a pressure of 400 lb/in^2, what will be the final temperature, if the pressure drops to 20 lb/in^2?

6 **36.** Steam of density 0.050 lb/ft^3 is supplied to a radiator at 212° F at a rate of 240 ft^3/hr. If the steam leaves the radiator as water at 72° F, what rate in BTU/min is heat being supplied to the room? (Heat of vaporization of water is 970 BTU/lb.)

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ROUGH WORK ONLY

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Values

8 **37.** A constant push of 10 lb wt is applied at an angle of 30° with the horizontal to a block of mass 20 lb which rests on a horizontal surface. This push gives the block a velocity of 32 ft/sec in 4.0 sec. Find the coefficient of friction.

LB 3054 C2 D419 1967a phy.30
Departmental examinations,
[grade 12] 1967, supplemental.
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